

NATURAL RESOURCES CONSERVATION SERVICE CONSERVATION PRACTICE SPECIFICATION

WOVEN WIRE FENCE

(Feet)

CODE 382(c)

I. SCOPE

The work shall consist of furnishing materials and installing woven wire or combinations of woven wire, barbed wire and/or smooth wire, at the location(s) shown on the plan map and (if needed) on the drawings or as staked in the field.

Fencing includes brace assemblies, gates, cattle guards, and other components required to meet site conditions and achieve objectives for practice application.

II. CONSIDERATIONS

Fence type and the fence design selected will be adequate to control the animal(s) of concern, and must be suited to the landscapes over which it will be installed and shall be adapted to the physical environment of the site.

Fence type and the fence design selected will be adequate to meet the intended life expectancy of the conservation practice.

Boundary fences shall comply with Nevada state laws and fencing codes or standards for construction.

Nevada Revised Statutes Part 569.431 (1991) defines a *Legal Fence* as, "...a fence with not less than four horizontal barriers, consisting of wires, boards, poles, or other fence material in use in the neighborhood, with posts set not more than 20-feet apart. The lower barrier must be not more than 12-inches from the ground and the space between any two barriers must be not more than 12-inches and the height of the top barrier must be at least 48-inches above the ground. Every post must be set as to withstand a horizontal strain of 250-pounds at a point 4-feet from the ground, and each barrier must be capable of withstanding a horizontal strain of 250-pounds at any point midway between the posts."

The NRS 569.431 definition for a *legal fence* is important for landowners to have knowledge of in designing fence to exclude livestock trespass as NRS 569.440 [1.(a)] states, "If any livestock break into any grounds enclosed by a legal fence, the owner or manager of the livestock is liable to the owner of the enclosed premises for all damages sustained by the trespass."

Woven-wire fence is best used in areas where tight control is necessary - sheep, goats, hogs, people, or predator control. Woven-wire fences can be adapted to most terrain, but are not well suited to areas of heavy snow loads.

Woven-wire fencing may not be suited for areas where passage of antelope, elk calves or deer fawns is planned for. "Let-down" fence spans or special structures, similar to cattle guards, can be installed in areas where big game travel is to be accommodated. See practice specifications for Let-Down Fencing, Water Gaps, Cattle Guards, and Other Fence Components, Practice Code 382(h). Also see wire spacing recommendations below.

III. SPECIFICATIONS

Woven-wire fences consist of woven wire stretched between line posts. The mesh of the woven wire differs, depending on the kind of animals the fence is designed to control.

MATERIALS

All fencing materials will be new, unless an exception is noted, with a minimum life expectancy of at least 10 years. *The materials used in construction must be in accordance with, and equal or exceed, in strength and durability, the following specifications:*

WIRE

Fencing materials shall conform to the requirements of American Society for Testing and Materials (ASTM) Standard Specification A121-92a for barbed wire, ASTM A116 for woven wire, ASTM A390 for poultry fence or netting, and ASTM A854 for high-tensile wire specifications. Woven wire and barbed wire shall have a zinc coating of at least 0.50-ounce per square foot of wire surface (or an equivalent protective coating) or have at least a Class 2 ASTM coating. Aluminum wire requires no protective coating.

When the size of steel wire is designated, the diameter shall be defined for U.S. Steel Wire Gage.

Each woven wire fence type has a design number that accurately describes the configuration of the fencing material.

MATERIALS (continued)**WIRE** (continued)

In reading the fence tag "Design No.", the first one or two numbers relate the number of line wires; the next two numbers to the right specify the height of the wire in inches; the next to last number grouping (either the number 6 or the number 12) identifies the vertical spacing of stay wires; and the final one or two numbers give the gauge of intermediate wires.

For example, woven wire with "Design No. 726-12-11", has 7 line wires, is 26-inches high, the vertical stays are spaced 12-inches apart, and the intermediate wires are No. 11-gauge. See Exhibit 2.

Intermediate wires (or filler wires) include the horizontal line wires and all the vertical stay wires between the top and bottom wires.

- Woven wire will have a minimum of 7 horizontal line wires and be at least 26-inches high.
- Spacing interval between vertical stay wires shall not exceed 12-inches.
- Top and bottom wires shall be at least No. 11-gauge wire while intermediate and stay wires shall be at least No. 14½-gauge.
- Top and bottom wires shall have at least a Class 2 zinc coating or equivalent corrosion protection.

The joints in woven wire fencing where line wires and stay wires connect should be of the hinge-joint type.

LINE POSTS

Woven wire fencing less than 36-inches high that is installed without additional strands of barbed wire will have exaggerated lengths of post projecting above the top line wire. Posts should not be shortened. Should livestock practices change and a higher fence be required, posts that have been shortened will need replacement.

Wooden posts are preferred for use in high snowfall areas because of their extra strength. Wood posts need not be new material; however, all posts should be of the most durable wood type available, such as juniper, cedar, locust, or eucalyptus.

In accordance with Federal Specification TT-W-571C, pine posts treated with a creosote-coal tar solution with not less than 10-pounds retention per cubic-foot or pentachlorophenol, with not less than six-pounds retention per cubic foot, are acceptable.

- Wood line posts shall be a minimum of 6½-feet long.
- At least 95 percent of the top of each wooden line post (two inches above the top wire) must be 3-inches, or larger, in diameter.
- Standard T- or U-section steel posts weighing not less than 1.33-pounds per foot of length, exclusive of anchor plate, may be used in lieu of wooden line posts where post strength is not important, or in rocky areas where posts must be pounded or drilled to be set.
- Steel line posts shall be at least 5½-feet long.

Steel posts shall conform to the requirements of ASTM A702. Steel posts are to be studded, embossed or punched for the attachment of wire and have an anchor plate near the bottom of the post.

Steel line posts shall be rolled from high carbon steel and have a protective coating. The coating may be either galvanizing by the hot dip process, or painted using one or more coats of high quality, weather resistant, paint or baked enamel.

Steel line posts will ground a fence as long as the soil is moist. In areas where lightning is a hazard, spacing steel line posts every 150-feet in a line of wood posts offers fair protection.

Fiberglass posts are lighter than steel posts and withstand greater side-to-side stress. Polypropylene plastic posts have adequate strength but special clips are needed to attach wire to the posts

- Fiberglass and plastic posts must be a minimum of 5½-feet long.
- "T"-shaped fiberglass posts need to be at least 1¼-inch in diameter.
- Round plastic posts should be at least 3⅜-inches in diameter.

BRACE POSTS

- All wooden corner, gate, and in-line vertical brace unit posts shall have a minimum top diameter of 5-inches.
- Wooden corner, gate, and in-line vertical brace unit posts shall have a minimum length of 7-feet.
- Wooden horizontal or diagonal braces shall have a minimum diameter of 4-inches.
- Wooden horizontal braces shall be a minimum of 6-feet in length.
- Wooden diagonal braces shall be a minimum of 6½-feet in length.

Wood brace posts shall be of cedar, redwood, juniper, treated pine or of other wood of equal life and strength. Pine posts treated in accordance with Federal Specification TT-W-571C are acceptable. Posts shall be sound, free from decay, with all limbs trimmed substantially flush with the body. All posts shall be substantially straight throughout their full length.

- All metal corner, gate and in-line vertical brace unit posts shall be at least 6½-feet in length.
- Steel pipe installed as posts shall have a minimum outside diameter (OD) of 3-inches or an equivalent weight of 7.58-pounds per lineal foot, or larger.
- Angle iron installed as posts shall have sectional dimensions of at least 2½ x 2½ x ¼-inch.
- Horizontal or diagonal cross braces will be new or used pipe at least 2⅝-inches (OD) in diameter or angle iron a minimum of 2 x 2 x ¼-inch in dimension.
- Steel horizontal braces will be a minimum of 6-feet in length.
- Steel diagonal cross braces will be a minimum of 6½-feet in length.

MATERIALS (continued)

BRACE POSTS (continued)

Steel brace posts and horizontal braces shall conform to the requirements of ASTM A702 for steel posts and ASTM A53 for bracing pipes. Steel posts and braces shall have a protective coating; either galvanized, or painted using one or more coats of high grade, weather resistant, paint or baked enamel.

Other: Specialty hardware is commercially available that allows the use of standard steel fence posts in design of fence end, in-line and corner brace structures.

Alternative types of materials and designs may be used for fence construction if: (1) they meet or exceed NRCS fence specifications; and, (2) they are approved in advance by the State Range Management Specialist.

Locally accepted fencing materials and fence configurations not addressed in Nevada NRCS fence specifications may be incorporated into the Field Office Technical Guide with prior approval of the State Resource Conservationist.

BRACING WIRE

Brace wires (tension members or guy wires) shall be formed from two complete loops of No. 9-gauge smooth wire or two complete loops of No. 12½-gauge double strand wire.

Tension wires shall have a tensile strength not less than 58,000 pounds per square inch and shall have a minimum of Class 2 zinc coating as specified in ASTM A 641.

STAYS

Stays and stay fasteners shall conform to the requirements of the appropriate ASTM for the fencing material specified, unless otherwise specified.

STAPLES AND CLIPS

Staples shall be No. 9-gauge galvanized wire at least 1½-inches long for soft woods and a minimum length of 1-inch for tight-grained, hardwood posts.

Fence line wire shall be fastened to steel posts using steel clips manufactured for this purpose or with two turns of No. 16-gauge, galvanized, wire.

CONSTRUCTION SPECIFICATIONS**ALIGNMENT**

Wire fences shall be reasonably straight and may not deviate more than 12-inches from a straight line between any corner and brace assemblies. Reasonable deviations in alignment shall be permitted where rocky ground or steep slopes make it necessary.

FENCE HEIGHT

The intended use of the fence determines fence height and line wire spacing.

The minimum height of woven wire fences shall be 26-inches, with a maximum height of 42-inches for all wires where wildlife considerations are planned.

If cattle or horses may be in the area, additional strands of barbed or smooth wire are needed above the woven wire. Smooth wire is preferred for horses to prevent injury.

LINE POST

- Wooden line posts shall be set solidly in the ground a minimum depth of 24-inches.

Wooden line posts can be driven.

Where post holes are dug for installing fence posts, the holes shall be at least 6-inches larger than the diameter or side dimension of the posts.

Post holes shall be back-filled with soil unless otherwise specified. Earth backfill around posts shall be thoroughly tamped in layers not thicker than 4-inches and shall completely fill the post hole up to the ground surface.

- Steel line posts shall be driven solidly into the ground a minimum depth of 18-inches. For very loose, sandy, soils set posts 24-inches deep.

Under moderate snow pack conditions, steel posts can be prevented from settling into the ground by attaching a wood stay to each steel post.

If soil conditions prevent firmly setting line posts in the ground, rock-jacks or wire cribs may be used. See practice specifications for Rock-Jack and Figure-4 Fence, Practice Code 382(f).

LINE POST SPACING

- Spacing interval is the same for all line post materials (metal, wood, etc.).
- Spacing interval between line posts for woven wire fencing without stays shall be 16½-feet.
- Spacing interval between line posts for woven wire fencing with 2, evenly spaced, stays shall be 30-feet.

CONSTRUCTION SPECIFICATIONS (continued)**CORNER, BRACE AND GATE POSTS**

Braces are required at all corners, gates, and at all definite slope breaks and changes in alignment to the line fence.

- In straight sections on moderate terrain, in-line brace units are required at intervals not to exceed 1,320 feet (80 rods).
- Corner brace assemblies shall be installed at all points where the fence alignment changes 20-degrees or more. Brace units are required at the beginning and end of each curved fence section.
- Brace units are required at any point where the vertical angle described by two adjacent reaches of wire is upward and exceeds 10-degrees.

The deeper a post is set, the stronger it will be. If soil conditions prevent the proper setting of anchor posts and brace posts in the ground, rock-jacks or wire cribs may be used.

- All wooden corner, gate, and in-line brace unit posts shall be set a minimum of 3-feet in the ground.
- Anchor posts (pull-posts) shall be set with a 1- to 2-inch lean away from the direction of fence pull.

Post holes for installing fence posts shall be at least 6-inches larger than the diameter or side dimension of the posts.

Post holes are to be back-filled with soil unless otherwise specified. Earth backfill around posts shall be thoroughly tamped in layers not thicker than 4-inches and shall completely fill the post hole up to the ground surface. Backfill shall be crowned-up around posts at the ground surface.

- Metal corner, gate, and in-line brace assembly posts shall be set in concrete a minimum of three feet in the ground.

Concrete backfill around posts shall be rodded into place in layers not thicker than 12-inches and shall completely fill the post hole to the surface of the ground. Concrete backfill shall be crowned-up around posts at the ground surface. No stress shall be applied to posts set in concrete for a period of not less than 24-hours following the development of a firm set of the concrete.

Wooden, horizontal, brace members (compression braces) shall be notched into the top half of the brace post, and post being braced, approximately 36-inches above ground level. Steel dowels or brace pins can be used, rather than notching, to attach horizontal brace between anchor post and brace post.

The elevated end of diagonal brace members shall be notched into the post being braced approximately 36-inches above ground level.

Metal, horizontal cross brace members (compression braces) shall be welded or notched into the top half of the brace post and post being braced at approximately 36-inches above ground level.

The elevated end of metal, diagonal, brace members shall be welded into a metal brace post, or notched into a wood brace post, approximately 36-inches above ground level.

BRACING WIRE

Brace wiring (tension member) shall consist of two wire strands that extend from a point approximately 6-inches below the top of the brace post to about 4-inches above the ground level of the post being braced (anchor post or pull post). The brace wires should be double wrapped around each post, stapled, and spliced together. A stout stick, pipe, or metal rod, about 18 to 24-inches long, is placed mid-way along the brace wires, and all four wires are twisted together so the brace wires tightly secure the compression brace and provide needed rigidity. If a diagonal brace is used, the tightening stick is positioned below the diagonal to avoid hitting this brace member as the stick is turned.

WIRE SPACING

In areas where big game animals are expected to cross the fence line, total height to the top line wire will not be more than 42-inches (40-inches is preferable).

If an additional line wire is installed above the woven wire fencing material, this top strand shall be set a minimum of 10-inches above the top of the woven wire at the post location. Where two, or more, line wires are installed above the woven wire, the top two wires shall be spaced a minimum of 10-inches apart (12-inches is preferable) at the post location.

Deer normally jump with their hind legs forward and the distance between the woven wire and top wire or between the two top wires is critical to adult deer. If the top two fence wires are loose or too close together, deer can entangle their hind legs and break the top wire - and entanglement can often be fatal.

Antelope can jump fences less than 30-inches high. To allow antelope passage through woven wire fences constructed more than 30-inches high, special structures, similar to cattle guards are needed.

CONSTRUCTION SPECIFICATIONS (continued)**WOVEN WIRE INSTALLATION**

Horizontal wires (line wires) of the woven fencing material shall be stretched and attached to posts as follows:

- The fencing wire shall be placed on the side of the post expected to receive the greatest pressure.
- Woven-wire will be installed 2 to 4-inches above the ground line at the post location.
- Where fencing is installed to protect a specific area, wire shall be placed opposite the area being protected.
- For installation along curved sections, fencing wire shall be placed on the outside of posts forming the curve.
- The fencing wire shall be fastened to wooden line posts by means of steel staples. Woven wire fencing shall be attached at alternate horizontal strands. Each strand of barbed wire shall be attached to each post.
- The fencing wire shall be fastened to standard T- or U-steel line posts by means of steel wire clips manufactured for this purpose; or with two turns of no. 16-gauge galvanized wire.
- The fencing wire shall be fastened to concrete line posts with two turns of no. 14-gauge galvanized steel or iron wire or in accordance with recommendations provided by the post's manufacturer.
- All line wires shall be dead-ended on the anchor post (pull post) of gate, corner, and in-line brace assemblies. Wire ends are double wrapped around the anchor posts (pull posts), stapled, and twisted back on the stretched line wire with at least six tightly wound wraps.

STAYS

Wooden or fiberglass stays may be required in areas where snow can damage the fence. When required, stays shall be evenly spaced between line posts to add strength to the woven wire fence.

SPLICING

When splicing line wires of woven wire fencing, the "Western Union" splice or suitable splice sleeves applied with a tool designed for that purpose shall be used.

The Western Union splice shall have no less than six (6) wraps of each end about the other. All wraps shall be tightly wound and closely spaced.

Splices made with splice sleeves shall have a tensile strength no less than 80 percent of the strength of the wire being spliced. To crimp wires together, overlap ends of each wire about two inches then place compression fitting over both wires and firmly crimp the fitting.

FENCE WIRE TENSION

A spring action is built into most woven wire by using tension curves configured as a "U"-shaped crimp in the line wire. Care must be taken when stretching woven wire to ensure that only about one-third of the wire tension curve is removed.

Temperature variations must be considered when setting the tension on line wires (wire will tighten in cold weather and expand in hot weather).

STAPLES

Steel staples shall be driven diagonally with the grain of wood. Staples shall be driven into the post at an angle in the same direction as the line wire is pulling *i.e.*, if the line wire pull is up, staple legs will angle upwards when driven into the post. Staples shall be driven just deep enough to snug the line wire without bending it. The line wire should be loose in the staple.

GATES AND OTHER FENCE COMPONENTS

Materials used in construction of wire gates shall conform to the kinds, grades, and sizes specified for a new fence, and shall include the necessary fittings and stays.

Panel gate fittings shall not be of a lesser quality than the gate manufacturer's standard.

Also see practice specifications for Let-Down Fencing, Water Gaps, Cattle Guards, and Other Fence Components, Practice Code 382(h).

CROSSING DRAWS OR STREAMS

When crossing landscape depressions (draws or swales), and fencing follows the ground surface, line posts subject to upward pull shall be anchored.

If the fence wire is installed with the top wire straight and parallel to the ground surface on either side of the depression, extra length posts shall be used to allow specified depth of post placement. Fence wire strands located over a depression should be anchored to a weight or deadman with No. 9-gauge, galvanized, smooth wire to maintain required spacing interval. Consider use of a deadman or anchor when the bottom line wire at the low spot in crossing rises more than 20-inches above the ground. Additional wires will be added for short distances between anchors as necessary. See Exhibit 9.

When crossing wide (greater than 16½-feet), or deep, stream channels or gullies the fence should be dead-ended on each side of the crossing by use of line braces. The section across a streambed may be removable, a breakaway type, or swinging picket type fence.

IV. INSTALLATION

Installation of the fence shall conform to the specifications and Exhibits or other drawings, as provided.

All posts shall be placed to the required depth and shall be firmly embedded so that there is less than 1-inch of horizontal movement at the top of post when a horizontal force of 80-pounds is applied.

The completed job shall be workmanlike and present a good appearance. The installer and other persons will conduct all work in accordance with proper safety procedures.

V. BASIS OF ACCEPTANCE

After the fence has been installed, a site inspection will be made to determine if fence construction, and the materials used, meet practice specification requirements.

VI. MAINTENANCE

This practice will require the performance of periodic maintenance.

Fence maintenance items to be alert to and corrected include:

- tension of wire
- bent or broken stays
- broken wires
- post alignment
- wire corrosion
- post stability
- pulled staples or clips
- sagging gates
- bent steel posts

REFERENCES

The following references provide excellent guidance for fence construction and fencing material requirements.

Henderson, G.E. Planning Farm Fences. American Association for Agricultural Engineering and Vocational Agriculture. June 1966.

Sanderson, R. et al. Specifications for Structural Range Improvements. General Technical Report PNW-GTR-250. USDA Forest Service-Pacific Northwest Research Station. September 1990.

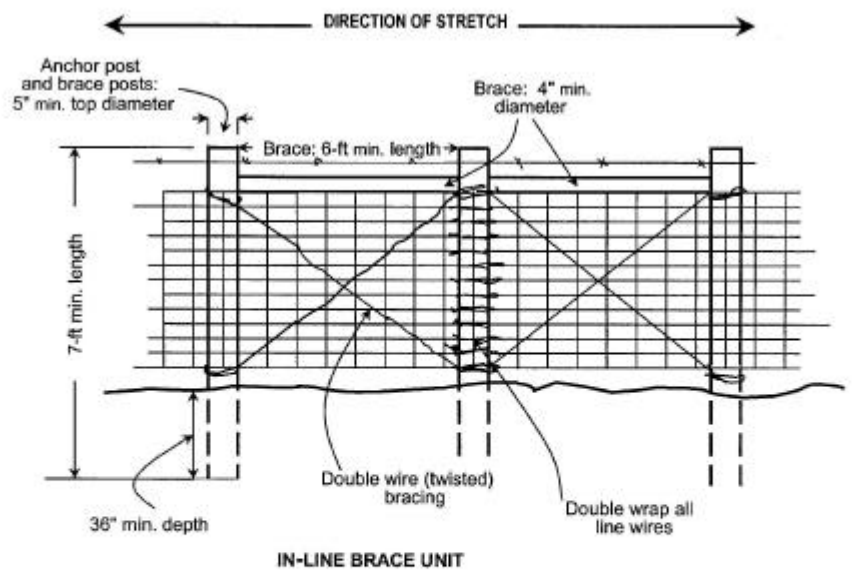
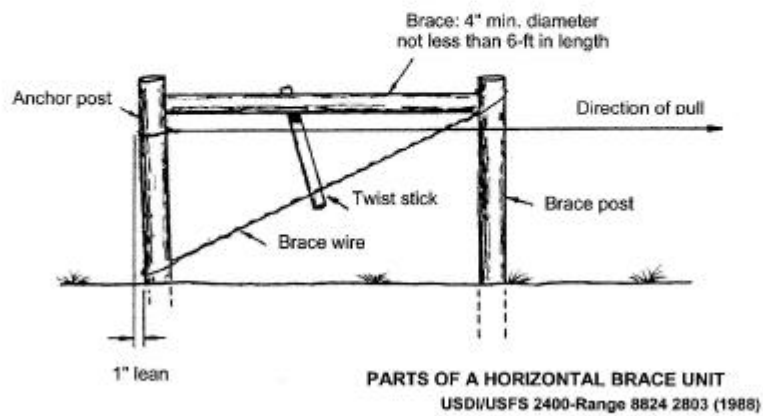
Turner, H.J. ed Building Fences. American Association for Vocational Instructional Materials. Athens, GA. 1974.

Turner, H.J. ed Planning Fences. American Association for Vocational Instructional Materials. Winterville, GA. June 1997.

Valentine, J.F. Range Developments and Improvements. Brigham Young Univ. Press. 1971.

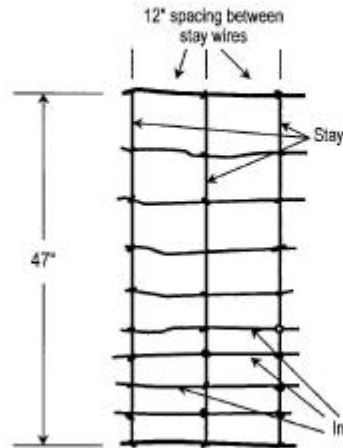
USDI Bureau of Land Management and USDA Forest Service. Fencing. 2400-Range 8824 2803. July 1988.

EXHIBIT 1



WOVEN WIRE FENCING

EXHIBIT 2

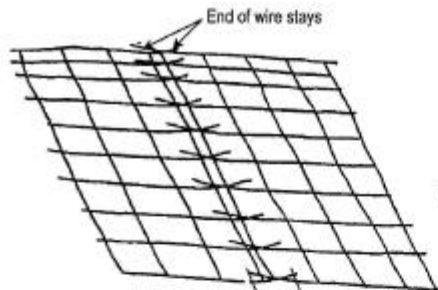


Woven wire fencing is available in eight standard heights and various combinations of horizontal wires, wire gauges, stay-wire spacing. Each type fence has a design number that describes the fence.

A Design No. of 1047-12-12½ has 10 horizontal wires, is 47-inches high, has 12-inch spacing of vertical stay-wires, and has No. 12½-gauge intermediate (or filler) wires. The top and bottom line wires of woven wire fencing are typically No. 9-gauge.

Design No. 1047-12-12½

WOVEN WIRE FENCE



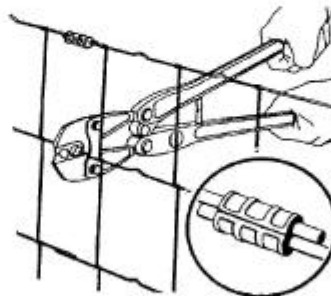
USDI/USFS 2400-Range 8824 2803 (1988)

SPLICING WOVEN WIRE FENCING

To splice woven wire, cut ends of line wire on each section so about 4-inches of each line wire extends beyond stay wire.

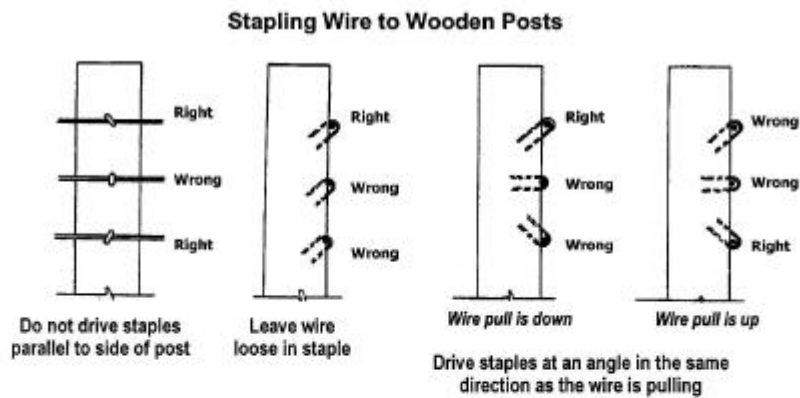
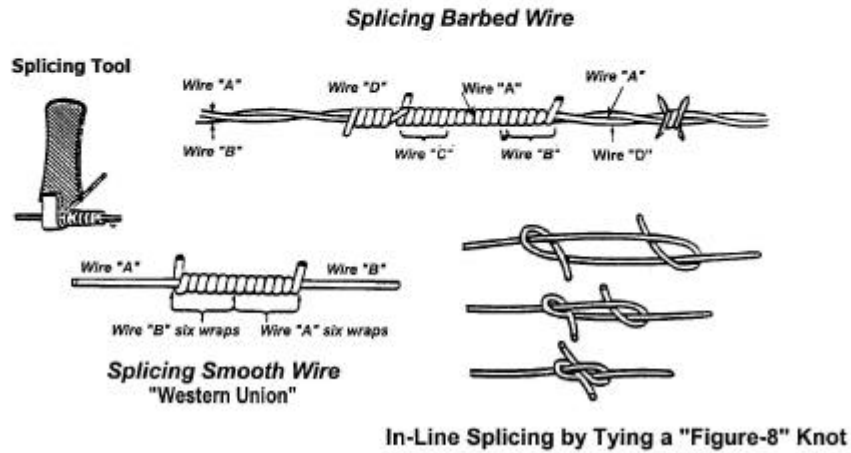
Pull ends of fence together until stay wires meet. Bend line wires of one fence section around line wires of the other fence section and wrap.

Also see Exhibit 3.



Commercial compression sleeves can be used to make splices on all types of wire.

EXHIBIT 3



after Sanderson et al (1990)